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ABSTRACT

This manual provides information needed to meet the standards for pesticide applicator certification. The thrust of this document is vegetation management in public service rights-of-way such as along utility lines, railroads and highways. Different categories of herbicides are discussed with attention given to how they should be applied, the effectiveness, and plant and environmental factors which should be considered with different application methods. (CS)

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RIGHT-OF-WAY
CATEGORY MANUAL

SE 024 023

This training manual is intended to provide you with the information you will need to meet the standards of the E.P.A. for pesticide applicator certification, and prepare you to take an examination given by the State of New Hampshire Department of Agriculture based on this manual. It is not intended to provide you with all the information you need for effective pest control. Additional information in the form of publications and short courses can be obtained from the Cooperative Extension Service.

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INTRODUCTION

Rights-of-way are the areas involved in common transport. Included are:

- Federal, State, county, and township highways and roads,
- public airports,
- railroads,
- electric utilities (including transformer stations and substations),
- pipelines (including pumping stations),
- public surface drainage ways,
- public irrigation waterways,
- banks of public bargeways, and
- bicycle, bridle, snowmobile, and other public paths or trails (outside established recreational areas).

Plant growth along the right-of-way must be controlled to make sure that the right-of-way is:

- safe,
- usable,
- attractive,
- as inexpensive as possible to maintain, and
- not harmful to the environment of the surrounding area.

VEGETATION MANAGEMENT

Consider what vegetation already exists along the right-of-way and what may need to be added. Usually grasses should predominate, but some legumes may be desirable. For added beauty and variety, encourage some wildflowers. Also consider shrubs with colorful fruit and berries.

Plants along a right-of-way that can be considered weeds are those which:

- are a safety hazard,
- are a nuisance,
- are unsightly,
- impede the use and maintenance of the right-of-way,
- cause injury to man or animals,
- have been legally declared "noxious",
- crowd out desired plants,
- damage structures such as road surfaces and rail ballast, or
- could harm adjacent crops if allowed to spread.

For weed control purposes, plants may be classed as grasses, broadleafed, or woody plants.

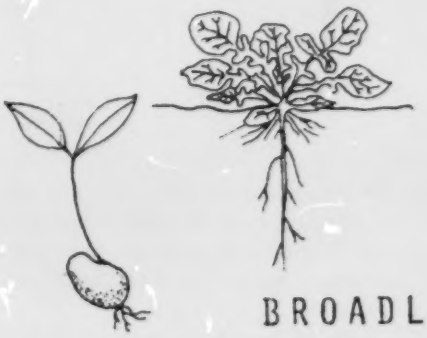
GRASSES

Young grass seedlings have one leaf coming from the seed. Grass leaves are generally narrow, upright, and have parallel veins. Many grasses have fibrous root systems.

GRASS

BROADLEAF PLANTS

Broadleaf plants have two seed leaves. They generally have broad, net-veined leaves and tap roots or coarse root systems.



BROADLEAF

WOODY PLANTS

Woody plants are those that form wood. They include:

- Brush and Shrubs—woody plants that have several stems and are less than 10 feet tall. When

trees are present, brush or shrubs may be called understory.

- Trees—woody plants which usually have a single stem (trunk) and are over 10 feet tall.

A plan for controlling plant growth along a right-of-way may include both nonchemical and chemical aspects. All the control methods must be coordinated, since each has an effect on the others.

NONCHEMICAL aspects of the plan might include:
- right-of-way location and design,
- erosion prevention and cover establishment,
- planting and encouraging desirable species,
- utilizing competitive characteristics of desirable plants,
- mowing,
- landscaping,
- equipment allocation, and
- controlled burning.

CHEMICAL methods include:
- fertilization, and
- use of herbicides.

TYPES OF HERBICIDES

SELECTIVE HERBICIDES

Selective herbicides kill certain kinds of plants but do not significantly injure others. Weeds must be correctly identified, and the right chemical must be correctly applied at the right time. Use spot treatments wherever possible instead of broadcast applications. (SEE Pg. 14)

NONSELECTIVE HERBICIDES

Nonselective herbicides kill almost all plants in the area of application. They may leave the soil nonproductive (barren) for a year or more, depending on the chemical and the rate at which it is used. Not all plants react the same way to any one herbicide. Your choice of herbicide and application rate depends on what plant you need to control.

Use nonselective herbicides in areas where bare ground is needed. This type of control may be necessary around substations, pole yards, pumping stations, storage areas, guardrails, signposts, runway lights, parking areas, railroad yards, in railroad ballast, in pavement cracks, and on highway shoulders.

Plants in these areas could be a fire or safety hazard, restrict sight, damage structures, provide a breeding area for rodents and other pests, or reduce security.

The herbicide must be able to:
- kill existing exposed plants, and
- keep others from growing during the desired period of time.

The application should be in a uniform pattern at rates recommended on the label.

Wind, water, and soil erosion can cause herbicides to move sideways after application and before the chemical is fixed in the soil. Be careful to prevent surface movement which could cause damage to desirable plants in adjacent areas. Herbicides seldom move off target when applied to ballast and pavement cracks.

Nonselective herbicides usually should not be applied to slopes greater than 6:1, horizontal to vertical, without protecting the ground from erosion.

The area can be protected by:

- covering it with asphalt or crushed stone, or
- mixing the herbicides with a cut-asphalt and spraying it over the surface.

Nonselective soil-applied herbicides kill existing perennial plants slowly. To improve their effectiveness, combine them with contact and/or translocated herbicides. You can mow existing plants closely and remove them before treating the area. Remove plants from around guardrail posts with a shovel. Blading with a grader can also be used.

PLANT GROWTH REGULATORS

A vegetation cover is sometimes needed where mowing is not practical. In some of these places, you can use growth regulators to slow down plant growth. They act only on the leaves they contact, so they create no hazard from moving off target in the soil. Because they generally do not create bare ground, they help prevent erosion. Use of these chemicals may cause an increase in undesirable plants, however, because not all plants are equally susceptible to them. (SEE P. 14)

CONTACT HERBICIDES

These are herbicides that control weeds by direct contact with plant parts. They must be applied to the leaves. They are sometimes referred to as chemical "mowers". Good coverage is necessary since only the plant area contacted is controlled. Most contact herbicides are nonselective.

Spraying of visible plant foliage starts the action of a contact herbicide. A sprayer is usually used to apply herbicide after growth has started.

Herbicide is taken into the plant leaves where it interferes with growth. The plant begins to curl, wither, and then turn brown.

Weed growth above ground is eliminated. Some weeds will not come back. However, some weeds may regrow from roots. New weeds may grow from seeds in the soil

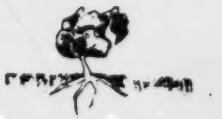
TRANSLOCATED HERBICIDES

These herbicides move through the entire plant system. They may build up in the plant's active growth centers. Most of these herbicides are selective. Some of them are most effective when applied to the plant foliage. (SEE P. 14)

Spray growing vegetation until wet.

Chemical translocates to growing points and roots

—and throughout the plant.



Susceptible plant gradually dies.

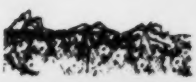
Other translocated herbicides must be applied to the soil. They are taken into the plant through the roots. These are called *soil residual* herbicides. The length of time the soil remains relatively weedfree depends upon the chemical used, amount applied,

rainfall, soil type, and the plant species in the treated area. Soil residual herbicides that are selective in some situations may be used nonselectively by increasing the rate of application.

Apply to soil and young plants in early spring.

Rain washes herbicide into the soil. It dissolves and is absorbed by the plant.

Herbicide is translocated to growing points. Plant yellows and gradually dies.



Plants die and ground may remain bare for a year or more.

FACTORS AFFECTING CHEMICAL WEED CONTROL

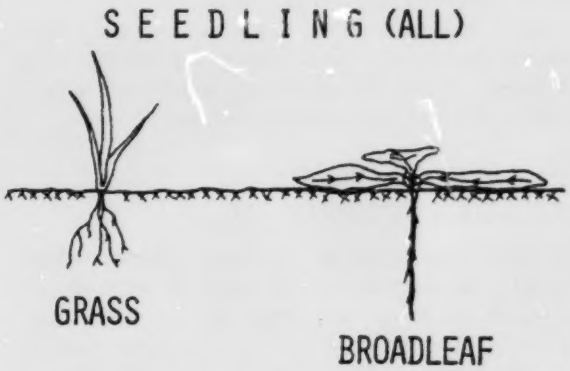
STAGES OF GROWTH

Grasses and broadleaf weeds go through four stages of growth:

- seedling,
- vegetative,
- bud and flowering, and
- maturity.

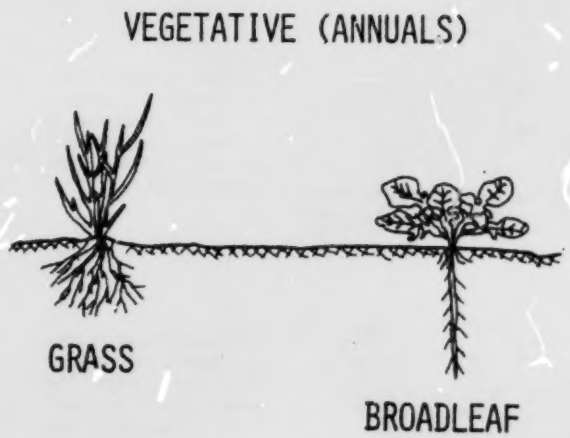
Seedling

The seedling stage of growth is the same for annual, biennial, and perennial weeds. They are all starting from seed. The weeds are small and tender, so less energy is required for control at this stage of growth than at any other stage. This is true whether mechanical or chemical control is used. Herbicides with foliar and/or soil activity are commonly used and usually effective at this stage.



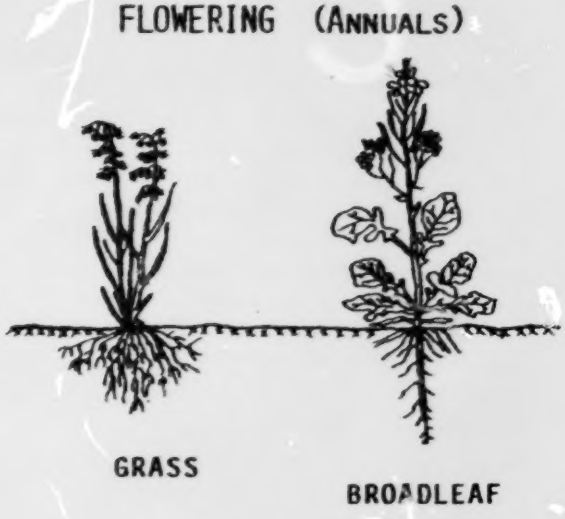
Vegetative (annuals)

During the vegetative stage of growth, energy produced by the plant goes into the production of stems, leaves, and roots. Control at this stage is still possible but sometimes more difficult than at the seedling stage of growth. Cultivation, mowing, and postemergence herbicides are effective controls.



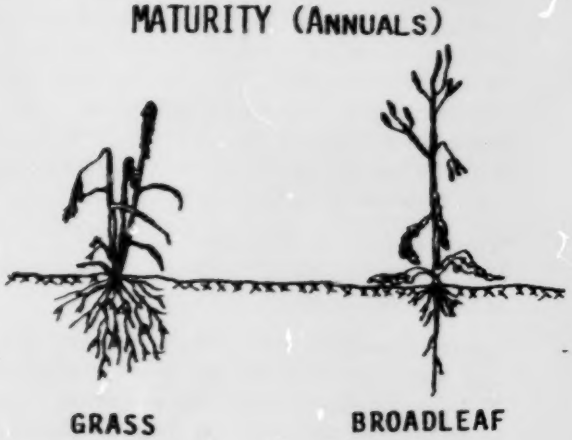
Bud and Flowering (annuals)

When a plant changes from the vegetative to the flowering stage of growth, most of its energy goes into the production of seed. As plants reach this more mature stage, they are usually much harder to control by either mechanical or chemical methods.

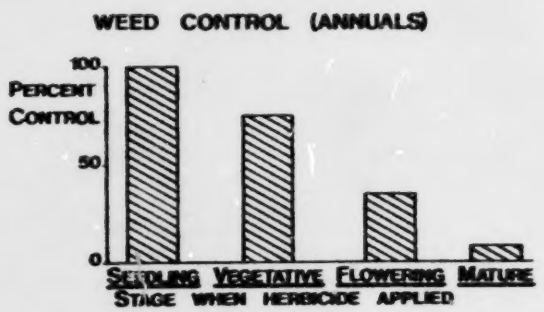


Maturity (annuals)

Maturity and seed set of annuals completes the life cycle. Chemical control is usually not effective at this stage since there is little or no movement of materials in the plant. Once the seeds are mature, neither mechanical nor chemical controls can harm them.



(Degree of control at any stage will vary according to the species of weed and the herbicide used.)

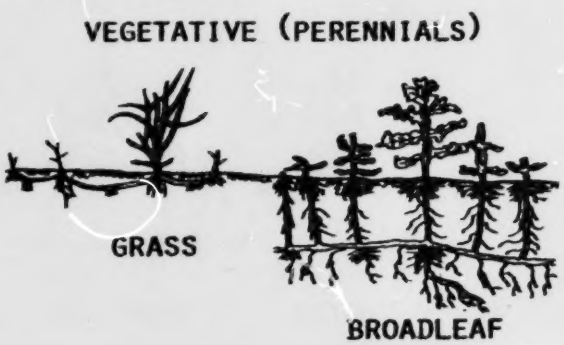


Biennials

Biennals, in two years, go through the same stages as annuals. Control is usually easiest during the seedling stage or when the weeds are still quite small.

Vegetative (perennials)

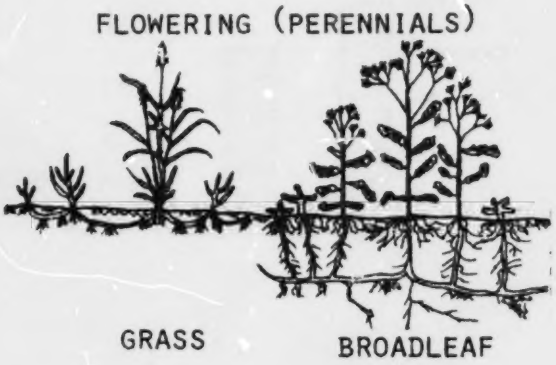
When the plant is small, part of the energy used to produce stems and leaves comes from energy stored in the underground roots and stems. As the plant grows, more energy is produced in the plant leaves. Some of this is moved to the underground parts for growth and storage. Herbicides provide some control at this stage.



Bud and Flowering (perennials)

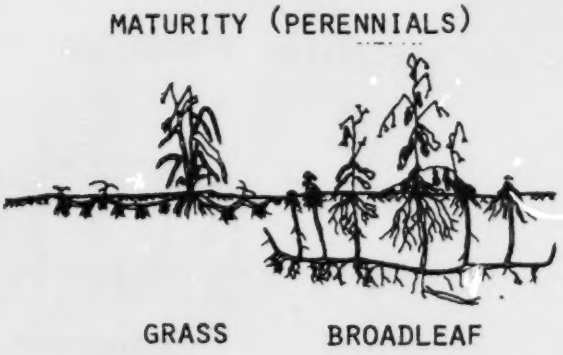
At this stage the plant's energy goes into the production of flowers and seeds. Food storage in the roots begins during these stages and continues

through maturity. Chemical control is more effective at the bud stage (just before flowering).

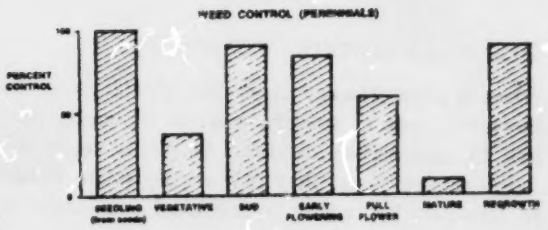


Maturity (perennials)

Only the above-ground portions of these plants die each year. The underground roots and stems remain alive through the winter and send up new plant growth the next spring. Chemical control is usually ineffective at this stage.



(Degree of control at any stage will vary according to the species of weed and the herbicide use.)



Woody Plants

Woody plants go through the same four growth stages as other perennial plants. They do not die back to the ground during the winter, but many kinds lose their foliage. Woody plants can be controlled with herbicides at any time, but control is easiest when the plants are small. Foliar treatments can be used at any time when the woody plants have actively growing leaves. They usually work best when the leaves are young.

TIME OF YEAR

With a fall application of an herbicide, the target plant must survive three stresses:

- the effects of the herbicide,
- the effects of winter, and
- the heavy demand for nutrients caused by the rapid growth period in the spring.

Fall treatments also may be safer for the environment, because many crops and other desirable plants have completed their growth.

Perennial weeds that have regrown after being controlled by chemical or mechanical methods should be treated in the fall. At that time, herbicides reach underground plant parts through the natural translocation activity of the plant. Before the first killing frost, nutrients move from the above-ground parts of the plants to be stored over winter in the underground parts. Underground parts must be killed to control these weeds.

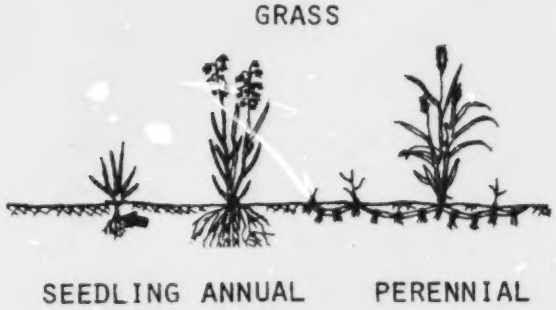
Winter annuals also can be more easily controlled by a fall application of herbicide, because they are seedlings at that time.

Spring treatments will control summer annuals and perennials while they are in the seedling stage. Fall and spring are ideal times to control biennials in the rosette stage. In the fall, translocation is occurring, and in the spring active growth begins again.

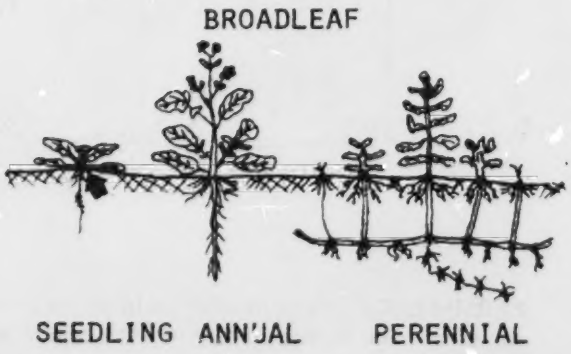
FACTORS AFFECTING FOLIAGE APPLICATION

Location of Growth Points

GRASS—The growing point of a seedling grass is protected below the soil surface. The plant will grow back if the herbicide or cultivation does not reach the growing point. Creeping perennial grasses have buds below the soil surface.



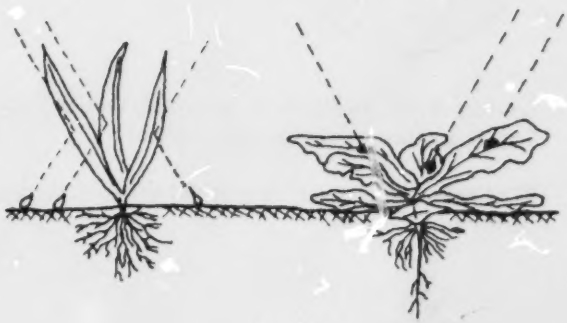
BROADLEAF—Seedling broadleaf weeds have an exposed growing point at the top of the young plant. They also have growing points in the leaf axils. Herbicides and cultivation can reach these points easily. The established perennial broadleaf plant is hard to control because of the many buds on the creeping roots and stems.



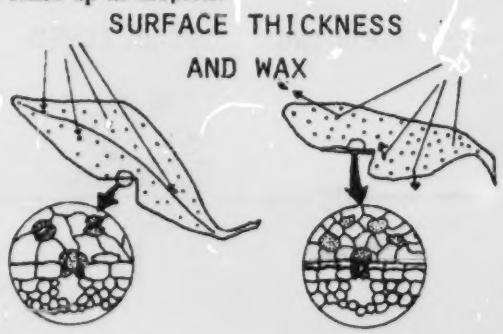
WOODY—Many woody plants, either cut or uncut, will sprout from the base or roots.

Herbicide Entrance Into the Weed

LEAF SHAPE—Herbicide sprays tend to bounce or run off of plants with narrow vertical leaves. Broadleaf plants tend to hold the spray. If recommended on the label, add an adjuvant to increase spray retention.



WAX AND CUTICLE—The herbicide must penetrate the leaf surface of the weeds. Thickness of wax and cuticle affect the entrance of an herbicide into a leaf. A leaf with a thin cuticle allows the spray solution good contact with the leaf surface. On a leaf with a thick waxy surface, the spray solution tends to stand up in droplets.



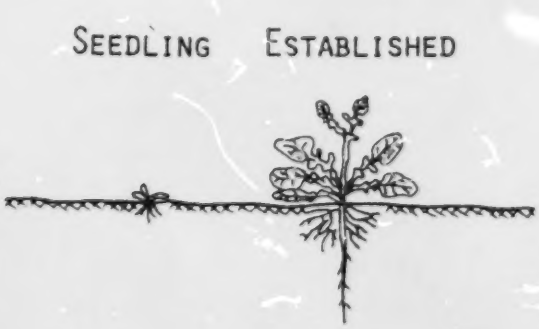
The wax and cuticle are thinner on young weeds. This is another reason for applying herbicides at the early growth stage.

HAIRS—Hairs on the leaf surface tend to keep the spray solution from entering. The droplets stand up on the hair and do not contact the leaf surface.

Seedling weeds usually have fewer and shorter hairs. This is another reason for early control.

SPECIES—Species vary in growth habits and susceptibility to herbicides.

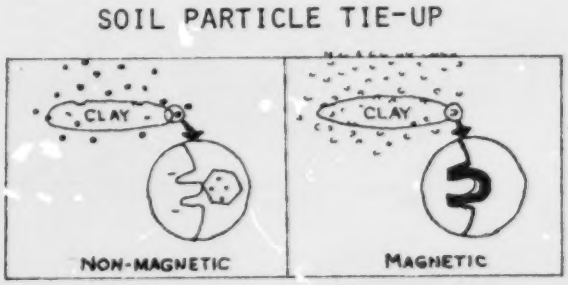
SIZE—Seedling weeds are easier to control than established weeds. Smaller plants, regardless of their stage of growth, are usually easier to control than larger plants.



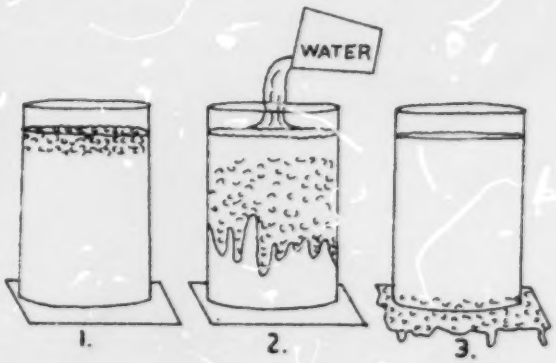
FACTORS AFFECTING SOIL-APPLIED HERBICIDES

Herbicide Characteristics

SOIL PARTICLE TIE-UP—One of the properties of herbicides is magnetism. Some are not magnetic at all; others have strong magnetism. Those without a magnetic charge move down through the soil quickly. Others, with positive magnetic charges, tend to tie-up on the negative charge sites of soil particles.



LEACHING—Leaching is related to herbicide characteristics and soil factors. Herbicides and soils vary from nonleachable to completely leachable.



PERSISTENCE—Persistence of an herbicide in the soil depends on herbicide characteristics, rate of application, soil texture, organic matter, precipitation, temperature, and surface flow. Herbicides can:

- remain concentrated at the soil surface,
- partially leach (diluting effect), or

- move through the soil in a front, allowing new weeds to grow above.

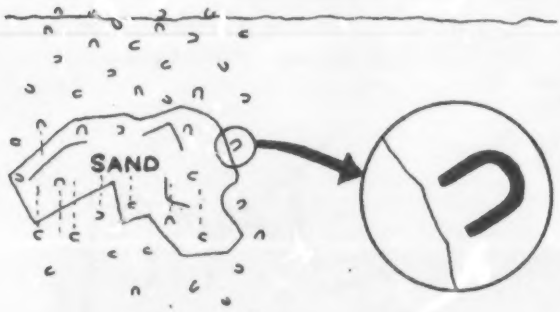
Soil Type

Two factors affect the movement of herbicides that are applied to the soil:

- the texture of the soil—how much sand, silt, and clay the soil contains, and
- organic matter in the soil.

TEXTURE—Sand is coarse and does not have many charge sites. The drawing shows a magnified sand particle in the soil. The magnet-shaped particles are herbicide molecules moving down through the soil. The magnified circle shows the herbicide particle moving past the sand surface. It does not tie-up.

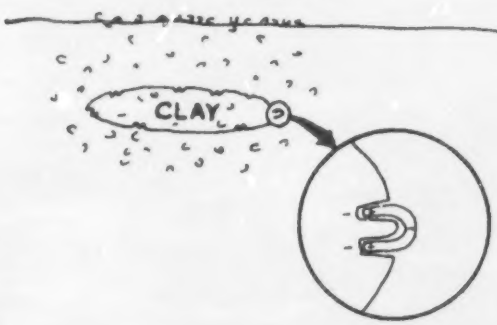
TEXTURE



Silt has more sites than sand, but fewer than clay and organic matter.

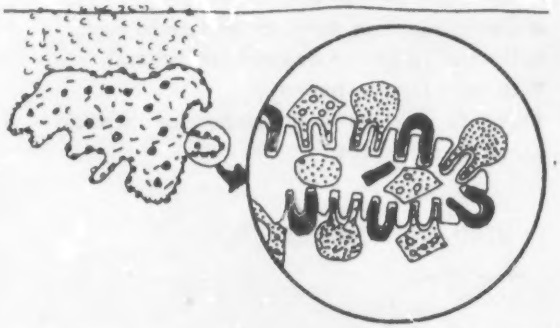
Clay is fine and has many charge sites. The drawing shows a magnified clay particle. The positively charged herbicide particle has fit into the negatively charged slots on the clay particle. It is tied up and will not continue moving through the soil.

TEXTURE



ORGANIC MATTER—Organic matter has many more negative charge sites than even the finest soil particles. The magnified circle in the illustration below shows not only herbicide particles tied up on the organic matter, but also particles of other materials such as water, sodium, calcium, and ammonia.

ORGANIC MATTER



OTHER FACTORS

Soil Moisture

Soil-applied herbicides must be in moist soil to be taken up by plant roots. This requires water in the form of precipitation or irrigation.

Temperature

Temperature generally does not affect weed control results. It may, however, affect the amount of time required for the herbicide to do its job. As temperature increases, the herbicide may work more quickly. In very cold weather, action of the herbicide may be slowed.

Humidity

A foliar-applied herbicide will enter the leaf more easily and rapidly at high humidity than at low humidity. At high humidity, the leaf is more tender and has a thinner layer of wax and cuticle.

Precipitation

If rainfall occurs soon after a foliar-applied herbicide treatment, it may decrease effectiveness. Rain increases soil moisture so soil-applied herbicides can be more readily absorbed by the weeds. But too much rain may move the herbicide too deep, past

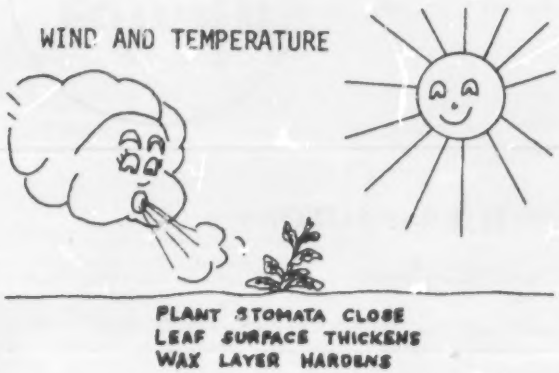
the zone where the weeds are. A hard rain may move surface-applied herbicides out of the target area. This is especially true if the soil surface is packed or sloping.

Wind and Temperature

Wind and temperature can also affect the weed. A hot, dry wind will cause:

- the openings on the plant surface to close,
- the leaf surface to become thicker, and
- the wax layer to harden.

These factors make it harder for herbicides to penetrate the leaves.



WOODY PLANT CONTROL

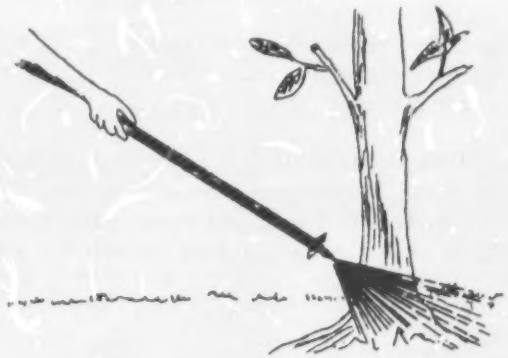
Woody plants may be controlled mechanically or chemically.

FOLIAR SPRAYING

Herbicides are applied to the foliage of woody plants. Spraying woody plants at a young stage of growth is best.

BASAL SPRAYING

Herbicides are applied in oil to lower parts of stems and exposed roots. It is best to fell large trees and then treat the stumps.



CUT-SURFACE TREATMENT

The herbicide can be applied to the sapwood through frill or notches. Another alternative is injection.

STUMP TREATMENT

Close-cut stumps and exposed roots also may be treated with herbicides in oil. It is best to treat immediately after cutting. All sprouts must be treated.

SOIL TREATMENT

Applications are made to the soil around the base of plants. Generally, granular herbicides are used. These must be in moist soil for results to occur.

DRIFT

Be sure that the herbicides you use do not drift to nontarget areas, either within the right-of-way or outside of it.

There are two kinds of drift:

PARTICLE DRIFT—spray droplets which are carried away from the application area by air movement. The distance a particle of herbicide spray can drift is determined by:

- the force of the wind,
- the distance from the spray nozzle to the ground, and
- the size of the particle. The smallest particles, such as those in fog or mist, present the greatest drift hazard.

VAPORIZATION—evaporation of an active ingredient during or after application. The movement of such vapor with wind currents may injure sensitive vegetation. Vaporization is not as common as particle drift, but it has more potential for moving a greater distance.

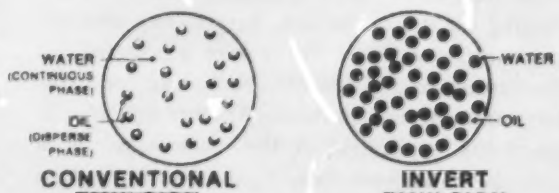
To reduce the chances for drift:

- Use the lowest practical pressures.
- Leave an untreated edge.
- Angle nozzles toward the ground, slightly forward in the direction of travel.
- Use nozzles with the largest practical openings.
- Use low-volatile formulations of the chemicals.
- Spray when wind speed is low.
- Do not spray during a temperature inversion (when air is coolest at ground level, gets warmer up to a certain height, and gets cooler from that point on up).
- Spray when sensitive vegetation is not actively growing.

DRIFT CONTROL AGENT

Special adjuvants and application systems have been developed to help overcome some drift problems. Three of these are:

- foams (tank mixed, conventional formulation with an additive),
- invert emulsions (three systems; mixed at nozzle, mixed at pump, or tank mixed), and



- spray additive stabilizers (thickeners in dry form mixed with conventional formulation in tank with agitation).

Though they differ in method, all three have similar advantages:

- better control of both particle drift and vaporization, and
- more highly visible spray, which allows you to see where you are placing it.

HERBICIDE APPLICATION EQUIPMENT

The equipment used is of two general types:

- airborne equipment, carried either by fixed wing aircraft or by helicopter, and
- ground equipment (including floating equipment on drainage ways, irrigation waterways, and bargeways).

Both airborne and ground equipment are available for applying:

- conventional sprays (water, oil in water, and oil in oil),
- invert emulsions, and
- granular formulations.

Rights-of-way have many obstacles which make the use of conventional spray booms difficult or impossible. The "manifold" sprayer (usually six nozzles with individual on-off valves, each set for different distances but with adjacent swath patterns) and the "handgun" sprayer nozzle are widely used. You also can get special equipment for applying herbicides to rights-of-way from aircraft.

Much special equipment has been developed for specific right-of-way jobs. It includes equipment for mounting on trucks, trailers, barges, rail vehicles, and all-terrain vehicles. The lack of a full range of well-adapted, readily available equipment for right-of-way spraying is a problem. Another difficulty in right-of-way application is the maintenance of a supply base. Because most rights-of-way are long and narrow, the operation continually moves away from its supply base. Return travel time is often excessive. Low application rates with minimum amounts of water or oil carrier make the job faster and more efficient since it reduces the supply runs. Mobile supply units are often needed. One unit, spray and supply combined, may be more efficient.

MANAGING AQUATIC PLANTS

Aquatic weeds are plants which interfere with the use or performance of water areas. They may:

- make the area less attractive,
- interfere with recreation,
- obstruct the flow of water in ditches or canals, and
- harbor insects or rodents.

The first step in control is to identify the general problem. Then you must identify the specific species to be controlled. Cooperative Extension Service personnel, written material, and herbicide manufacturers' representatives can help you.

The basic approaches to aquatic weed control are:

- design and construction of the water area,
- operation and maintenance,
- mechanical control, and
- chemical control.

The best control method is that which gives safe, effective weed control while causing the least harm to other parts of the environment.

CHEMICAL CONTROL

The use of herbicides to control weeds in water areas is often very effective. Use the herbicides as the label directs.

As you analyze any aquatic weed problem, consider the following:

BIOLOGICAL ASPECTS:

- Identify the problem species.
- Identify other species present.
- Determine the density and stage of growth of the weeds, and how much area they cover.
- Determine what species of fish are present.

WATER USE ASPECTS:

- Know the uses of the water in the treatment area.
- Find out how long the water can be quarantined from each use.
- Know how much water leaves the treatment area and what it will be used for.

EXAMPLES OF TYPES OF HERBICIDES USED IN N.H.

Selective: Selective for general woody plant control and control of most annual and perennial broadleaf weeds.

TORDON- TORDON 101 Mixture; .5 lbs picloram plus 2 lbs. 2,4,D/G.
TORDON 155 Mixture: 1 lb. picloram plus 4 lbs. 2,4,5,T/gal. as esters.

SILVEX- KURON
WEEDONE 2,4,5-TP

2,4,5,T- WEEDAR 2,4,5-T amine
WEEDONE 2,4,5-T ester
and others.

Selective for most annual and perennial broadleaf weeds.

2.4-D- WEEDONE LV-4 ESTERON 99 CONCENTRATE
CHIPMAN 2,4-D WEED-RHAP LV 4D

DICAMBA- BANVEL

Selective for some broadleaf weeds and grasses.

SIMAZINE

Non-Selective:

AMS- AMMATE X
BROMACIL- HYVAR-X UREABOR
KROVAR-L BORCIL

Plant Growth Regulators:

MALEIC HYDRAZIDE- SLO-GRO

Contact Herbicides:

PARAQUAT- ORTHO PARAQUAT

Translocated or Systemic Herbicides:

HORMONE TYPE- Picloram
NITROGEN METABOLISM ALTERATION- 2,4,-D, Dicamba, Picloram, Atrazine, Simazine.
INHIBITION OF ENZYME ACTIVITY- 2,4-D, 2,4,5-TP.
DISTURB CELL DIFFERENTIATION- 2,4-D, 2,4,5-T, 2,4,5-TP.

EXAMPLES OF KINDS OF PLANTS FOUND IN NEW HAMPSHIRE

GRASSES: Quackgrass, bluegrass, red fescue, poverty grass, timothy.

BROADLEAF PLANTS: Canada thistle, milkweed, burdock, clovers, bindweed.

WOODY PLANTS: Poison ivy, alder, maple, pine, willow.

WEED AND BRUSH CONTROL ON RIGHTS-OF-WAY

Chemical control of unwanted vegetation on non-food areas--such as waste places, driveways, and parking lots, along roadsides and ponds, under utility lines, and in pasturelands and forests--is a common practice in New Hampshire.

The control of weeds is related to the continued conservation and wise use of our energy resources and technological growth. Today, however, good brush or weed control must be equated with more than just wiping out or reducing undesirable vegetation. Programming is the key to acceptable brush control, for example. In chemical brush control, you plan the application of various chemicals--choosing the proper chemical and carrier, selecting the right method of application, and choosing the right time to apply to provide the most adequate vegetative control from year to year for the most economical cost per acre or per mile.

Under today's public pressures, the initial cost of product and efficient application are not the only criteria of success. Your program, well-planned in advance, must be ecologically sound, environmentally safe and aesthetically pleasing, as well as effective.

Herbicides can generally be classified as selective or total in their effects on control of vegetation. Examples of selective, total, and combination methods are discussed in the following areas:

Utility Rights-of-Way Vegetation Management (Selective)...page 16

Roadside Vegetation Control (Selective).....page 21

Railroad Vegetation Control (Combination).....page 22

Vegetation Control in Industrial Areas (Total).....page 25

UTILITY RIGHTS-OF-WAY VEGETATION MANAGEMENT (SELECTIVE)

Several million miles of utility rights-of-way, ranging from 20 to 200 feet wide, exist in the United States. Fifteen years ago, the Rural Electrification Administration was made up of 1,030 systems serving 4,600,000 customers and had 1,426,000 miles of rights-of-way in operation. Today, overhead transmission lines alone occupy 4,000,000 acres of right-of-way land with an average width of 110 feet. The estimate for 1990 is growth to an average width of 115 feet on a total of 7,000,000 acres.

Many of these utility rights-of-way have been constructed through forest and brush lands. On such areas, the utility company must practice selective vegetation management to control tall-growing woody brush which may interfere with transmission line performance and maintenance. The economic advantage of chemical treatment over hand cutting is easily determined by simple cost analysis.

Right-of-way management begins with an inspection of a proposed right-of-way. During the inspection, any special or unusual cutting procedures are determined.

Clearing contractors must practice selective cutting to preserve desirable shrub and tree species in buffer strips on both sides of paved roads extending at least 100 feet into the wooded area to be cleared. When treating buffer strips, these requirements must be met:

Prevent damage to plants that are to be saved.
Do not burn in the buffer area.
Do not pile brush or logs or limb wood in the buffer area.
If a roadway for vehicles is necessary, it must be a single lane constructed so it cannot be seen from the highway.
Leave all dead or fallen trees, dead brush, and stumps wherever they do not interfere with construction work or access.

Where topography and line conductor heights will permit, entire areas of right-of-way are left uncut to provide a natural tree barrier to screen the power line from the public's view.

The utility company determines the specific herbicide, volume of application, and method of application for cut stumps. It also prescribes the minimum amount of chemical solution for each right-of-way.

Each chemical treatment on utility rights-of-way should reinforce and extend the low-growing ground cover plant species that are most adaptable to the soil, moisture, and climatic conditions of that particular right-of-way. The development of a stable, low-growing ground cover will, over the years, require a minimum of maintenance at the lowest cost.

CONTROL OF SOIL EROSION

During the construction of new power lines, heavy machinery damages the soil. To prevent serious erosion and stream silting, drainage ditches must be constructed, and the graded areas must be revegetated. Grass seed mixtures,

lime, fertilizer, and mulch will control soil erosion and silting after runoff water is controlled by installing cross-drainage ditches.

Right-of-way management programs are based on field inspections and prescribed treatments for each section of power line right-of-way. Seasonal variations influence the chemical formulations to be used and the method of application.

WILDLIFE MANAGEMENT ON UTILITY RIGHTS-OF-WAY

Growing national concern over deteriorating environmental quality and dwindling wildlife habitats has focused attention on many forms of open space that might be developed to meet the requirements of natural animal populations. Powerline rights-of-way are a form of open space currently under consideration as potential wildlife corridors.

A variety of vegetation provides both food and protection for animal life. Recently cut-over forests, with the subsequent growth of herbaceous plants, bushes, and young stages of trees, support much more animal life than the original tree cover. Ground dwelling birds, such as partridge, whippoorwill, pheasant, and woodcock are encouraged by the open conditions, as are rabbits, deer, woodchucks, foxes, and others.

Most of our farms are essentially cut-over forest land with selected woody and herbaceous plant life replacing the original trees; and farms most certainly support a host of animals. Thus, the cleared land around pipe lines and electric lines can provide conditions where many forms of animal life can develop. Fairly recently, some utility companies have become interested in ground cover which will actually encourage wildlife.

Many pipelines have been in the ground for several years. This has created dense ground cover of coarse perennial herbaceous plants, with some bushes and trees intermixed. To establish optimal plant life, this dense ground cover must be overcome by the bushes and small trees selected to grow there.

Wildlife biologists are showing interest in power company real estate. The four million acres of transmission line rights-of-way in the United States represent a significant amount of potential wildlife habitat for management.

By incorporating careful vegetative management and habitat manipulation into right-of-way construction and maintenance programs, power companies can produce positive impacts on the wildlife populations along the transmission route. Further planning efforts for multiple recreational use of the rights-of-way can give the public an opportunity to enjoy wildlife.

APPLICATION METHODS

SELECTIVE BASAL TREATMENT

The selective basal treatment is most successful when the brush stem population is relatively sparse. It is usually the best method to treat tree species of brush intermixed with desirable low-growing shrubby plants. Since this method employs oil as a chemical carrier, it can be applied during the dormant season when the brush is without foliage.

The selective basal method is not as successful as other application methods on very dense brush or on the root-suckering tree species, but is usually the most aesthetically acceptable method to the public.

All woody plant species in the right-of-way, except species designated to be left for future ground cover, should be treated with chemical in oil to saturate each stem completely at the ground line and to a height of 12 to 18 inches on the stem, and to completely encircle each stem. Where sprout growth originates from a stump, the treatment should also be applied to completely encircle the stump at the ground line, including any exposed roots.

All chemical solutions are applied by nozzlemen walking the right-of-way. The applicating equipment may be either power-driven equipment or knapsack spray tanks. Spray nozzles should be adjusted to produce a coarse spray of large droplets at 30 pounds or less pressure.

All stems of ash species over one inch in diameter at a point three inches above the ground line should be removed by completely cutting at the three-inch height. The brush from this mechanical cutting must be disposed of in a manner acceptable to the property owner. Stumps should be treated, after cutting, according to the utility's specifications for selective basal treatment.

WATER-BORNE STEM-FOLIAGE TREATMENT

The water-borne stem-foliage application is moderately effective on most tree species in New Hampshire and can use a variety of chemical herbicides to suit any brush species composition. It can be applied fairly selectively to retain desirable plant species, but is not as successful as selective basal treatment. Because it uses water as a chemical carrier, it is most successful if applied during the growing season when plants are in full leaf. (The accompanying "brown-out" of the treated foliage is at times unacceptable.)

With the correct herbicide, this application is most successful on root-sucking tree species and on rights-of-way where the brush density is high. The transportation of large volumes of water over difficult terrain can however, make this method uneconomical. If applied carelessly, it can cause off-the-right-of-way damage from spray drift.

HELICOPTER APPLICATION

The chief advantage of the helicopter is its adaptability on rights-of-way over rough terrains that are too difficult to traverse by truck or on foot. The uniform dispersal of chemical solutions over the right-of-way from the air gives good brush control with a fraction of the gallons of solution required by ground application. In addition, when treating tall brush (10 to 20 ft), better control of spray can be achieved from the air. Because the application by the helicopter is so rapid, its use can be restricted to periods of little or no wind, providing almost absolute wind drift control. In recent years, the development of the microfoil boom, a spray rig that accurately controls droplet size and drift, has further improved aerial application of herbicides.

Several disadvantages of the helicopter application restrict its use. Chemical treatment by helicopter is limited to the broadcast-type application. The application covers 100 percent of the right-of-way and cannot be applied selectively. The practice of side trimming trees along the right-of-way edge with the helicopter application is a misuse of this otherwise effective and useful application method. This practice is offensive to the landowner and the viewing public and should be discouraged.

In addition, the helicopter naturally attracts more public attention than conventional equipment. This can be detrimental due to the growing controversy over the use of chemical herbicides.

When using helicopter application, it is necessary to contact the landowner in advance to prevent damage to fruit and berries, gardens and pastures, evergreen tree plantations, or other crops not readily recognized by the helicopter pilot during the spray operation. The aerial applicator has more controls imposed on him than the conventional ground applicator.

When applying herbicides to rights-of-way by either water-borne stem-foliage or helicopter application, spraying must be discontinued within 100 feet of all improved roads and highways. The selective basal treatment is substituted at that point.

CHEMICAL RECOMMENDATIONS

Three methods of herbicide application and some of the chemicals that may be used are: (1) Selective Basal: butoxyethanol or propylene glycol butyl ether esters of 2,4-D and 2,4,5-T and a formation containing a combination of the trisopropanolamine salt of 4-amino-3,5,6-trichloropicolinic acid plus PGBEE of 2,4,5-T; (2) Water-Borne Stem-Foliage: the same chemicals as Selective Basal (except no picolinic acid is used as a waterborne spray), plus 2,4,5-T amine, 2,4-D and 2,4,5-T emulsamine, 3-amino-1,2,4-triazole, and ammonium sulfamate; (3) Helicopter: inverted emulsion of 2,4-D and 2,4,5-T, and 4-amino-3,5,6-trichloropicolinic acid plus particulating agent. Each of these treatment methods has been widely used and is well known. Occasionally one method has been employed to the exclusion of the others In New Hampshire, due to variations in terrain, climate, vegetation species, and land ownership, the greatest success in right-of-way management is achieved by choosing the chemical herbicide and application method that best suits the right-of-way conditions.

STUMP TREATMENTS

Effective control can be obtained with the use of 2,4,5-T esters at a concentration of 17 pounds per 100 gallons of oil, or 2,4-D plus 2,4,5-T esters at 16 pounds per 100 gallons of oil. Ammonium sulfamate applied as crystals to the cut surface or in a solution of 4 to 6 pounds per gallon also effective.

SOIL APPLICATIONS

New pellet forms of substituted ureas at 75 to 100 pounds per acre either as a dry mix or in a slurry have shown great promise. With this material, aerial application is possible in remote areas. Injection needles, using 2,4,5-T at a rate of 8 pounds per 100 gallons oil, has been used to get the chemical into the ground at the base of the plants.

ROADSIDE VEGETATION CONTROL (SELECTIVE)

Highway maintenance forces must care for roadways and shoulders, and are also responsible for vegetation control on the roadside. For many years, vegetation control was done mechanically--by hand. Selective herbicides were later introduced and approved for use on roadways. About 15,000,000 acres of roadsides and highways cross the United States. From the standpoint of ease and economy, roadside spraying is justified: Once the weeds and brush are eliminated, the prevailing grasses are given a chance to establish themselves; in many locations, the roadside banks are steeply sloped, full of rocks and debris, and not accessible to mowing equipment; when snow removal is necessary, roadsides that are free of weeds and brush are easy to maintain.

Using herbicides on highways increases highway safety by eliminating tall weeds, and allowing an unobstructed view of warning lights, traffic lights, crossroads, driveways, and curves.

Herbicides control broad-leaf weeds, reducing the number of required mowings. Drainage areas are kept free of weeds and brush which impede water flow. Herbicides also reduce the possibility of weeds infesting neighboring crops, and eliminate toxic plants and allergy-causing weeds.

CHEMICAL RECOMMENDATIONS

Many herbicides are available for vegetation control along roadways. Among these are Fenac, Amitrole, Tritac, Erbon, Hibor, 2,4-D and 2,4,5-T, Dicamba, Diquat, Sodium Chlorates, Simazine, Atrazine, Bromacil, Diuron, Amizine, Tordon, and others, depending on whether long- or short-term vegetation control is desired.

In recent years there has been considerable interest in growth-modifying chemicals which would control growth rather than destroy it. Among the more common herbicides used for this purpose is Maleic Hydrazide.

RAILROAD VEGETATION CONTROL

Effective control of vegetation on railroad rights-of-way is similar to that on roadsides. More soil sterilants are used however, because the railroad ballast must be treated. Two general problem areas of weed control along railroad rights-of-way are the track or roadbed, and the off-track area or right-of-way.

WEED CONTROL ON THE ROADBED (SELECTIVE)

On the roadbed, vegetation cannot be eradicated, but must be controlled to establish a cover of low-growing perennial grasses to protect cut-and-fill sections from erosion. Trees, vines, annual weeds, and tall-growing grasses must be eliminated or controlled because their growth on the roadbed will:

Interfere with efficiency of track maintenance that is done from the top of the roadbed. (Men do not work effectively when vegetation is snagging at their clothing, and they are apprehensive of stepping on hidden obstacles or pests.)
Make it difficult to unload material.
Create fire hazards.
Make train inspection difficult or ineffective.
Obstruct view of signs at crossings.

The objective for vegetation control on the roadbed, then, is to eliminate vines, briars, trees, annual weeds, and establish a cover of low-growing grasses.

WEED CONTROL ON THE RIGHT-OF-WAY (TOTAL)

On the right-of-way, vegetation control is necessary only in special circumstances, such as:

The presence of a wire line: to prevent interference with communications.
Road crossings: to prevent obstruction of view.
Urban or developed areas: to eliminate complaints associated with overgrowth.
The presence of noxious vegetation: to comply with laws requiring its eradication.

The justification for vegetation control is primarily economic. Dollars are wasted through inefficiency when vegetation is not controlled. In addition, the hazards created by weed-infested tracks and overgrown roadbeds can produce an unfavorable public image. This, too, can be costly in terms of antagonism and harassment from individuals and public officials.

Control methods along railroad rights-of-way include manual removal, burning, rotary mowing, and chemical control. Burning is being replaced by other methods because it is not selective, is almost as expensive as chemical control, does not destroy root systems, and creates a fire hazard. Rotary mowing is still used at crossings and along rights-of-way because local ordinances frequently prescribe it. However, as local ordinances change and better techniques become available, many railroads are replacing mowing with chemical treatment.

Chemical control ranges from selective to total. Achieving and controlling bare ground is expensive and requires high rates of soil-sterilizing chemicals followed by reduced rates of residual materials.

Continued use of only one chemical will cause encroachment of vegetation which must be controlled by other herbicides.

In the past, woody plants have been difficult and expensive to control. A method which is becoming popular is dormant treatment of brush with brush killers. It offers a high degree of control and the application can be made when the susceptible crops are not growing. Other brush control methods used include basal and modified basal applications, cut stump, frill, and girdle tree injection.

The following discussion lists specific areas of railroads and reasons for vegetative control:

Ballast section -	to maintain proper drainage; to allow ties, fastenings, and switches to be inspected, increasing the life of the tie; to keep weed seeds out of traction motors on diesel engines; and to prevent wheel slippage.
Shoulder adjacent to ballast -	to promote drainage.
Shoulder -	to give unrestricted vision and allow inspection of trains.
Bridges, buildings, and other structures -	to maintain fire safety.
Yards -	to maintain safety, convenience, and appearance.
Low switch stands and dwarf signals -	to give better view.
Inside of curves -	to inspect trains.
Under communication lines -	to maintain uninterrupted service.
Area adjacent to tracks -	to keep trains from fouling.
Highway grade crossings -	to allow unrestricted view for both autos and trains.
Signs (mile posts, whistle boards) -	to give optimal view.

Weed control improves the appearance of the railroad.

CHEMICAL RECOMMENDATIONS

Some examples of herbicides and their rates of application that have been tested on railroads in recent years are:

Borate - chlorate mixture (35% active chlorate) - 6 lb/100 sq ft
Ammate - 300-350 lb/acre (Kudzu control)
Trysben - 8-10 lb acid equivalent per acre (Kudzu control)
Trysben - 4 gal in 100 gal of water used on sumac, conifers, persimmon, sassafras, black locust and willow
2,4-D - 6 lb
2,4,5-T - 6 lb (for Trumpet Creeper)
Diesel oil - 97 gal
Sodium TCA - 100 lb/acre, or
Borate Chlorate - 6 lb/100 sq ft (for Johnson grass)

SWITCHYARDS, TRANSFORMER YARDS AND FENCES

Telvar - W (active) - 25 lb/acre
Aminotriazole - 10 lb/acre
Simazine - 50 lb/acre
Aminotriazole - 25 lb/acre

Tennessee Valley Authority field tests have shown that:

1. Because of the many types of vegetation near railroads, a combination of chemicals is required;

2. Wet sprays are more expensive and less effective;

3. Earlier applications are more effective; and

4. Chemical mixtures, either pellets or granules, applied by mechanical spreaders, are more effective and economical.

VEGETATION CONTROL IN INDUSTRIAL AREAS (TOTAL)

The control of vegetation in waste places, industrial plants, penal institutions, lumber yards, airports, tank farms, storage areas, parking lots, and along fence rows presents weed problems to many persons. For example, the farmer recognizes that weeds growing in or near non-crop areas are sources of potential weed infestation to other parts of his property; unwanted brush and weeds around fields harbor insects, diseases, and other pests that may be detrimental to farming operations; and shrubs like wild cherry are possible sources of livestock poisoning.

Chemicals are an alternative to mowing in areas where top-kill of short vegetation is desired. They are economical and convenient, especially close to fences, around buildings, or where the terrain is rough. Herbicides used for this kind of short-term general control are first applied when the growth is about six inches high.

Tall vegetation is more difficult to kill and can become unsightly as well as a fire hazard when it dies. Treatments for this kind of growth are made with contact chemicals which "burn" any leaves they touch. Subsequent treatments, two or three during the season, are required to keep the cover short.

It may be desirable to maintain some areas completely free of vegetation. This involves destroying the existing vegetation--including the underground stems and roots of perennials--and then maintaining the bare area with long-term soil sterilization or with foliage treatment of weed seedlings.

Some soil sterilants will kill existing vegetation. Others, while excellent for maintaining a bare area, are more economical combined with another chemical to kill existing growth. If a mixed population of weeds is present, combinations of chemicals may be used. Uniform coverage with all chemicals is essential. Touchup operations should be expected, because a single treatment seldom gives complete eradication.

The duration of weed control obtained with soil sterilants depends on several factors: rainfall, soil composition, type of chemical, and amount applied. Control is usually maintained for a longer time in heavier soil types than in sandy soils and gravel areas.

CHEMICAL RECOMMENDATIONS

Several of the more important chemicals used for short-term vegetation control are Amino Triazole, Diquat, Paraquat, Liquid Cyanimid, Sodium Chlorate Mixtures, and Ammate.

Some of the long-term total vegetation control herbicides are Ammate, Amizine, Bromacil, Bromacil plus Diuron, Diuron, Prometone, Simazine or Atrazine, Tandex, and Monuron.

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Railroads

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Industrial Areas

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SUPPLEMENT TRAINING INFORMATION FOR CATEGORY (B)
RIGHT-OF-WAY, (WEED AND BRUSH CONTROL)

The following list will serve as an example of a few of the herbicides available for Weed and Brush Control. This list, and the uses indicated, is by no means complete but is offered as a guide to some of the commonly used herbicides, based on current labels. This information should be helpful to applicators in preparation for their category examinations.

The following are some common herbicides used along right-of-ways in New Hampshire. Included is a general use application description for each chemical and precautions relating to drift and use of the material in aquatic situations.

2,4,5-T - Woody Plant Herbicide

2,4,5-T can be used to control woody plants along utility right-of-ways and may be applied as a foliar or basal application. Foliar sprays are generally mixed with water, whereas basal sprays (i.e., stump, basal bark, and frill applications may be applied as a 2,4,5-T/oil mixture. Ester formulations of this chemical are very volatile and should not be used around desirable plants and ornamentals. 2,4,5-T should not be used around homes or residential areas. 2,4,5-T should not be used in or near aquatic areas or watershed areas. It is highly toxic to fish. This material cannot be used on ditchbanks.

2,4-D - Woody Plant Herbicide

2,4-D is registered for use on Right-of-Ways to control woody vegetation. It may be mixed with water and applied as a foliar spray or mixed with oil for a basal bark, stump or frill treatment. Some ester formulations are very volatile and drift may injure off-target species. Fruit trees and ornamentals are very susceptible to drift. 2,4-D is toxic to fish and should not be applied near waters This material can sometimes be used in watershed areas with prior approval from the Board.

2,4,5-TP (Silvex, Kuron) - Weed and Brush Herbicide

2,4,5-TP is registered for use on Right-of-Ways to control weed and brush in a water base stem-foliage spray. It may also be used in forest land for basal and stump treatment of weed species. Some formulations of 2,4,5-TP are registered for use in aquatic situations. Ester formulations are likely to drift. This material can sometimes be used in watershed areas with prior approval from the Pesticide Control Board.

Bromocil (Hyvar)

Bromocil is registered for use in non-crop areas and may be mixed with water in some formulations. It is registered for use on right-of-ways as a broadcast treatment or as a basal (spot) treatment. It should not be used in aquatic situations, on brush growing in waters, or on shore lines where it may wash into waters.

Ammonium Sulfamate (Ammate X) - Weed and Brush Killer

Ammate X is a non-selective, non-volatile herbicide. It can be used as a contact spray for weeds and grasses and also for control of undesirable woody plant species in brush control along right-of-ways. It may be mixed with water

for stump treatments and frill treatments and it may be mixed with an oil-water emulsion for foliar spray applications. Ammate X-Nl is specially formulated for use in controlling weeds and brush in proximity to aquatic areas. This material can usually be used in watershed areas with prior approval of the Pesticide Board.

Arsenicals (MSMA, Silvisar, Cacodylic Acid)

Formulations are made to be mixed in water. Some formulations are registered for use along right-of-ways to control weeds. Cacodylic Acid is formulated to be used with a special hatchet/injector tool for individual stem treatment.

Dicamba (Banvel) Brush Control, Foliar Spray

Dicamba (Banvel) is formulated either in combination with 2,4-D or 2,4,5-T, or the formulation may contain only Dicamba and other chemicals may be mixed with it before application. Dicamba may be applied as a dormant stem broadcast treatment, foliage application, or basal bark treatment. Certain formulations of Dicamba may be applied to areas in close proximity to aquatic areas; i.e., draining ditch, river banks. Aerial, stem foliage, and foliage sprays may be mixed in water or oil. Basal sprays are usually mixed in oil. This material can sometimes be used in watershed areas with prior approval from the Pesticide Control Board.

Simazine (Princep)

Simazine is a pre-emergence herbicide and a soil sterilant. It is registered for use as a weed control chemical in forest plantings to keep weeds from competing with young forest plantings. At higher application rates, Simazine can be used for nonselective weed control on non-crop land.

Picloram

Picloram is registered for use in the control of broadleaf and conifer trees. It is frequently used for treating right-of-ways.

Tordon 101 or Amdon 101 - Weed and Brush Killer

Tordon 101 is registered to be used in non-crop areas only. It is a mixture of Picloram and 2,4-D and is made to be mixed with water. It can be used as a ground or aerial foliage treatment, or it may be used with a tree injector or in frill treatments of individual stems. Tordon 101 is highly active against most broadleaf plants and drift to non-target plants should be avoided. Tordon 101 should not be applied in aquatic situations or to shorelines where it could be washed into waters.

Tordon 155 or Amdon 155 - Brush Killer

Tordon 155 is registered for use in non-crop areas. It contains a mixture of Picloram and 2,4,5-T and is made to be mixed with oil (petroleum solvent). It is recommended for use on right-of-ways using basal bark treatments or dormant stem treatments. Tordon 155 is highly toxic to fish and should not be used in aquatic situations or on shorelines where the pesticide may be washed into waters.

Paraquat - Contact Herbicide

Paraquat is registered for use along right-of-ways. It is a highly toxic material and should be used with caution. Paraquat is formulated to be mixed with water. Paraquat is toxic to wildlife and should not be applied on or near aquatic areas. Paraquat is a contact herbicide that kills all green plant tissue. Drift should be avoided.

PLEASE NOTE:

The Pesticide Control Division does not, in any way, endorse the chemicals or their use that appear on this list. In addition, there are many other materials that can be used in various situations and the uses listed for the materials are only partial uses. Pesticide applicators must review the labels of those herbicides before using.